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Automobile Parking Space Detection Using Open Cv

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ABSTARCT
In this work, automatic counting of the parking spaces on behalf of a vehicle is detected using OpenCV. This open-source computer vision library detects and tracks the parking spaces used and unoccupied in real time. The system feeds live videotape from a camera mounted in the parking lot and applies image processing styles to identify vehicles. The crucial approach is grounded on, originally, background deduction for determining if the moving Objects (buses) are present, followed by figure discovery and morphological processing for bounding the presence of buses in the matching areas of the parking spaces.[1]
Following the discovery of vehicles in the terrain the system develops a floorplan of the vacuity of parking spots and checks if the parking spots are in use. Each of the spaces is determined in advance in the system and when a vehicle is linked to be in a space the state of the space is changed to" engaged" and space is set to" available. The state of each parking space is in real time and real-time information about their vacuity is given. This system, besides saving time, also contributes to parking operations becoming much more effective by reducing business backups and directly guiding vehicles to an available spot in a short time.[2]
The presented result leverages the power of OpenCV's image processing and object discovery to make an automated, robust, scalable, and scalable platform for parking operations. Because of its real-time monitoring along with its stoner-friendly interface, this system is an effective useful tool to be espoused in small-scale parking lots or large parking lots, optimizing the parking space and the whole process of parking. likewise, it is also a pledge for its farther development, similar in combination with mobile operations, in which machine literacy models may be used, and the perpetration of innovative discovery and tracking functionalities.[4]

Keywords: Python, OpenCV, Vehicle Detection, Parking Space Detection, Parking Slot Counter, Image Processing.

1. INTRODUCTION

In particular, in the scenario of the increasing vehicle traffic density within the urban street, proper traffic management plays a larger and larger role. Classical, e.g., manual tracking or hardware sensors, do not generally offer real-time information so inaccuracies, susceptibility, library, OpenCV, for computer vision based on parking vacancy counting, is being presented.[1]
Specifically, within the framework of video streams from cameras, the system identifies and localizes space occupancy providing a sensor less, low-cost, and versatile alternative as a countermeasure to the

sensor-based counterpart. The technology will find more applications ranging from grass fields to carpark lots, underground garages, etc. and it is an efficient, environmentally friendly solution to current parking problems.[2]

As can be seen, the presented system has exploited the phylogenic nature embedded in OpenCV (i.e., background subtraction and object detection) to detect an arbitrary amount of parking places using only a single camera hardware. In contrast with sensor-based systems, this article is a low-cost, scalable, and less-maintenance type of system. User interfaces are designed to be more efficient by minimizing the time spent looking for pay lots and by minimizing the area needed by pay lots. In a real-time feedback and high-speed image-based processing environment, the system can be used to implement optimization of traffic flow and saving of fuel, therefore it serves as a foundation for intelligent urban parking systems.[3]

2. LITERATURE SURVEY

In the paper, "Detection of car parking space using OpenCV", the authors tackle the challenge of parking spot detection, which is an important but practical problem of finding unoccupied parking spaces in urban areas with a high concentration of cars and traffic intensity. They discuss a vision-based intelligent parking system, controllable and monitorable by computer vision traction for live use in a parking lot. In this device, the parking lot is divided into pure blocks (the camera pictures belonging to each block are designated either an occupied image or a free image), which form the source of the images used by the cameras. Real-time location information on all accessible parking areas is transmitted to the drivers, through the driver's mobile application, the real-time update check function of which thus guarantees the current information on all available parking areas. The method is based on aerial views captured with an aerial camera, parking spot tracking, and occupancy tracking by a binary transformation and thresholding. Visual green spaces are visually presented as open and are red as frequently used spaces.[1]

Conceptually, a lightweight and real-time image processing system in Python based on the OpenCV and NumPy libraries, achieving high detection accuracy (up to 99.5% detection success rate). Performance, however, may be influenced by the background (e.g., bright irradiance), etc. According to experts, there are continuations of improvements (e.g., more automation, incorporation of parking decks in sites, luxury functionalities in handling automated payments, and bulk parking structures). Its unique value is the introduction of a more versatile and stable system so that it is applicable to a wider class of parking scenarios.[1]

In the research article "Car Parking Space Counter Using OpenCV", an approach is presented to overcome urban parking issues like traffic jams and air pollution. It combines an ultrasonic sensor with computer vision algorithms to provide real-time (ie, dynamic) information on whether the parking space is clear or not. Space is sensed via ultrasonic sensors and the parking lot scene is sensed and processed by OpenCV algorithms to facilitate vehicle tracking and the update of status of occupancy.[2]

The system is equipped with a simple and intuitive interface, built based on a mobile/web app, providing the users with an easy way to automatically detect empty parking lots, preventing unnecessary transportation and traffic bottlenecks. It has a wide range of applications for both static and dynamic parking garages and is very robust to various indoor/outdoor environments such as lighting, weather, and floor plans.[2]

This paper describes a vision-based, intelligent parking detection system that can help the driver quickly find and secure an empty parking space with high population density in urban areas, which can overcome the shortage of parking spaces and greatly shorten the time spent in parking space searching. With streaming video from cameras, and system uses image processing methods to identify vehicle occupancy in partitioned parking blocks. Drivers receive real-time information about the parking status of the area achieving an impressive accuracy of up to 100% for different weather conditions and 99.5% in total tests from a comparison of detected and target car occupancy. The system shows great promise in traffic congestion and fuel consumption reduction, and in improving parking management efficiency.[3]

This study paper presents an image processing-based system as a solution to the emerging problem of car parking space availability, which leads to traffic jams, and parking problems. The system delivers real-time information on parking occupancy, respectively, optimizing parking space utilization, and avoiding the waste of gas at the parking lot entrance. Due to a low infrastructure cost and the limited hardware needed, the system uses few cameras to observe the whole parking lot. System performance is reported experimentally, including its capability for accurate detection and real-time display of parking occupancy as visualized via a graphical user interface.[4]

3. PROBLEM STATEMENT

The problem of real-time parking information makes it difficult to achieve an optimal level of efficiency in the parking management of urban areas for which delays, traffic congestion, and fuel consumption are problems. Existing one-dimensional systems based on manual observation or expensive sensor-based observation are prone to such errors and difficult to extend, whereas external factors such as lighting changes, weather, and shading will also influence the performance of detection. Systems based on OpenCV help to solve these problems by the application of camera viewpoints for birds-eye views, preprocessing of images to improve image quality, and the use of edge detection and contour extraction to find public car parks. Real-time parking availability is reported through dashboards or apps, providing accurate and efficient performance. Nevertheless, current challenges include processing of environmental variability, robust detection accuracy in dense lots, and cost vs. computational efficiency for broad applicability.[2]

4. DESIGN AND IMPLEMENTATION

Input module for video capture, a pre-processing module for image enhancement, a detection module based on YOLO which allows implementing vehicle detection, a counting module to determine the occupancy, and an output module that displays the parking status. With the aid of image processing, object detection using OpenCV, and implementation in Python, the system is intended to be cost-effective, scalable, and applicable to a variety of environments. It employs algorithms optimized for efficiency to process video streams with good performance characteristics, including noise reduction, control of lighting conditions, and ROI mapping to locate unattended and unoccupied spaces.[1]

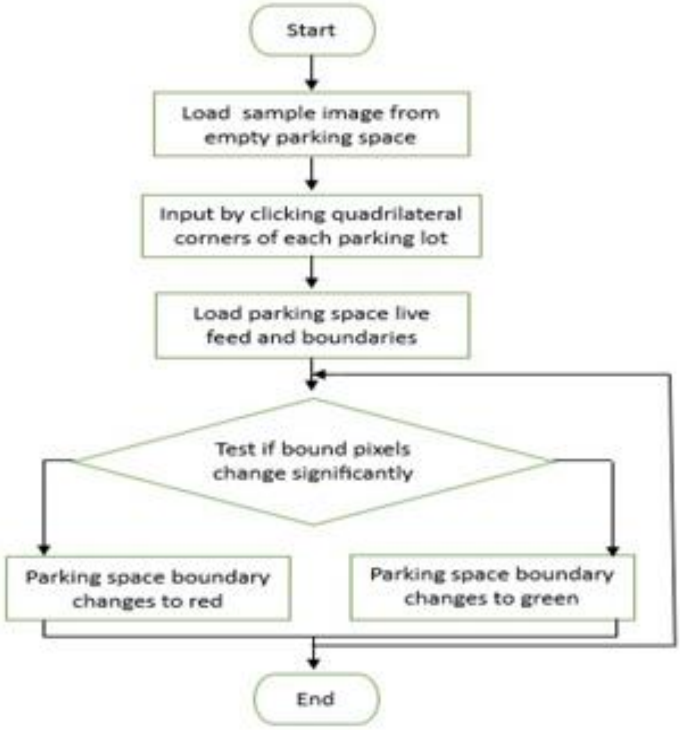

Fig.1 Implementation of Car Parking Space Counter

The flowchart represents a parking space detection system where:

1. As a sample image, an empty parking space is shown.
2. Quadrilateral corners of each parking space are defined.
3. Live parking space feed and boundaries are loaded.
4. Pixel changes are analyzed to determine occupancy.
5. Boundaries turn red if occupied or green if vacant.

The system's architecture guarantees an effective operation of the parking system through continuous streaming and analysis of the images, identification of vehicles, and continuous live occupancy information through the graphical user interface. Even though all are based on assumptions, e.g., unobstructed views and homogeneous parking spaces, the method is shown to be adaptable for both indoor and open-air environments. However, due to the finite nature (e.g., potential environmental issues and video quality) of a system, the system is shown to be cost-effective, scalable, and real-time, which makes it a viable solution for today's parking needs, alleviating congestion while maximizing the utility of the parking space.[4]

5. TESTING AND RESULTS

In the testing and results chapter, a detailed description of the behavior of the parking space detection system in a wide range of environmental and technological situations is presented. The system was tested on controlled indoor and uncontrolled in-the-wild, dynamic, lighting, weather, and traffic dynamic environments. Actively controlled testing provided good accuracy, and the results showed consistent detection and occupancy tracking within an environment of uniform illumination and vehicle presence. Nevertheless, evaluation in real-life tasks showed drawbacks such as loss of accuracy with night or meteorological conditions (rain, fog). Due to these results, it is evident that also new requirements exist for [better]higher- level preprocessing techniques and, of course, better lighting conditions for a robust performance of the system in diverse applications.[2]

Performance measures (accuracy, real-time throughput, error rates) also illustrated the capabilities and limitations of the systems. The daylight imaging (a relatively high accuracy of 96% was attained, which at night was down to 87% of results). The system delivered an average frame rate of 20 FPS on the high-performance building block GPUs provided by the high-performance computing platform GPUs, which allowed for real-time computing, compared to a low-end platform.[3] Scalability tests revealed the presence of a system that can be operated with a total of 100 parking garages at low latency, however, at the scale of more widely deployed applications, distributed or cloud-based architectures are required. The analysis of GPUs, which allowed for real-time computing, compared to a low-end platform. Scalability tests revealed the presence of a system that can be operated with a total of 100 parking garages at low latency, however, at the scale of more widely deployed applications, distributed or cloud-based architectures are required. The analysis of errors showed the contribution of false positives (e.g., shadows and static objects mistaken for motor vehicles) and false negatives (i.e. occlusion of motor vehicles in high traffic density) and pointed towards the necessity of more sophisticated strategies of detection algorithms, as well as larger datasets.[5]

Despite its limitations, the system demonstrates significant practical value. Because of its cost efficiency, how it utilizes existing surveillance infrastructure, and its reliability in controlled conditions it offers a viable choice for present parking management. However, there remain some problems such as hardware dependency, environmental, and scalability issues, which need to be solved to make its benefits a reality. Recommendations are termed to involve hardware cost, distributed computing, and larger training sets to generalize over unevenness in the real world for robust and accurate performance when variability is the norm. These developments would assure the adaptation of the system to anticipate future requirements and, in consequence, to future needs thanks to their access to the Internet of Things (IoT).[4]

OUTCOMES

The above data is pictured in the next graph.

6. CONCLUSION AND FUTURE WORK

In conclusion and future work, the performance, limitations, and future work in computer vision-based parking space counting systems are discussed. The system successfully provided real-time examples of park-and-go surveillance over existing surveillance infrastructure and provided high-accuracy real-world results as well as economic viability by not needing any sensor-based technology. State-of-the-art computer vision methods, including YOLO for object detection, paved the way for scalable and adaptable solutions across a range of parking environments. However, environmental dependence, weather dependence, static camera dependence, manual ROI, and scalability constraints make this a fertile area for further research. Limitations were most obvious when illumination, occlusion, and weather were bad, and the performance of the system decreased.[1]

Additional steps are discussed including additional optimization for detection accuracy supported by high-level image pre-processing robustness under adverse weather conditions models and the incorporation of infrared cameras. Automation ofROI detection, further together as distributed or edge computing, can enhance scalability and performance rather than moving the entire processing to the edge. By integrating the use of IoT sensors, vehicle identification, and intelligent dynamic parking guidance systems, the application of the system may be generalized beyond classical vehicle traffic management applications to some environments such as hospitals or airports. Additionally, algorithmic enhancements in the form of model optimization and better tracking algorithms are proposed to enhance the computational efficiency/accuracy for challenging situations. These advances lead to more robust, highly versatile, and expansible parking management (infrastructure).[2]

REFERENCES

1. Rahul Tekam, Shoheb Shaikh, Leela Bitla, Pranav Rathi and Hiamnshu Chambhare.” Car Parking Space Detection Using OpenCV” easy chair preprint, Jan-2023.
2. Anant Sharma, Harshmeet Singh Maan, Mr.Rohit Maheshwari.” Parking Space Counter using Opencv” Career Point International Journal of Research (CPIJR), ISSN: 2583-1895, vol. 4, Dec2023.
3. Nazia Bibi, Muhammad Nadeem Majid, Hassan Dawood, and Ping Guo “Automatic Parking Space Detection System” 2nd international conference on multimedia and image processing, October-2017.
4. Ambika Gupta, Sudhansu Kumar “Parking Space Counter using Image Processing” International journal of scientific research in engineering and management (IJSREM), issn:2582-3930, vol.07, Aug-2023.
5. Using Video Images" in the Transportation in Journal of the Transportation Research Board in 2015.
6. In 2009, Zhang Bin, Jiang Dalin, Wang Fang, and Wan Tingting presented a paper on "Design of a parking space detector based on video image" in the Electronic Measurement & Instruments journal.
7. S. Vishwanath, S. Sharma, K. Deshpande, and S. Kanchan, "Vehicle Parking Management System," 2020 International Conference on Convergence to Digital World - Quo Vadis(ICCDW), 2020, pp.1-6,doi:10.1109/ICCDW45521.2020.9318673